2. PURPOSE AND NEED FOR ACTION

2.1 PURPOSE

The purpose of this document is to assess the potential environmental consequences of the proposed action to select borosilicate glass as the waste form for the Defense Waste Processing Facility (DWPF). The DWPF will immobilize the high-level radioactive waste generated and stored at the Savannah River Plant (SRP).

Potential environmental impacts of an alternative waste form and its selection process are also included in this document.

2.2 NEED FOR PROPOSED ACTION

Since 1953, SRP has been producing special nuclear materials for defense purposes. Chemical separations of irradiated fuel and targets at SRP result in product streams and acidic liquid streams that contain almost all of the fission products and small amounts of transuranics. Currently, this waste is chemically converted to an alkaline solution and stored in large underground tanks at SRP as insoluble sludges, precipitated salts, and supernatant (liquid).

The Department of Energy (DOE) has initiated activities to dispose of the defense high-level waste generated at SRP. As part of the system approach, the high-level waste will be immobilized into a highly dispersion-resistant waste form;* canisters of the immobilized waste are to be later emplaced within multibarrier systems in deep geologic repositories. Construction of the DWPF, which will produce the waste form, is currently scheduled to begin in 1984; operation of the DWPF is scheduled to begin in 1990.

* The DWPF will be constructed in stages.[1] First, the insoluble sludge (containing most of the strontium-90 and the actinides, and presenting the greatest long-term radiological hazard) will be immobilized. Next, radioactivity in the precipitated salt andm supernatant (primarily cesium-137, plus small amounts of strontiu and actinides) will be removed and either recovered for beneficial use or mixed with the sludge feed prior to immobilization. The current plan is to dispose of the decontaminated salt on the SRP site as low-level radioactive waste.

When conceptual design of the DWPF was started in 1977, borosilicate glass was selected as the reference waste form on the basis of extensive DOE studies. In FY-1979, the National High-Level Waste Technology Program was established to develop the technology for immobilizing high-level waste into solid waste forms which would provide highly efficient barriers against radionuclide release to the environment. Since the inception of the program, seventeen candidate waste forms have been developed and characterized by some fourteen participating contractors. Based on screening evaluations,[2,3] as well as on work at SRP and other laboratories, the number of forms under consideration was reduced from seventeen to seven. Further assessments culminated with the selection in November 1981 of two forms--borosilicate glass and a crystalline ceramic--for consideration as the final DWPF waste form.[4]

Based on data on waste form characteristics and expected repository performance, DOE is ready to select the final waste form for the DWPF. It is desirable to make the final waste form selection as early as possible to allow firm design of the DWPF, to reduce the scope of alternative waste form studies, and to increase efficiency by concentrating research and development on a single form.

2.3 RELATION TO OTHER PROGRAMS

2.3.1 Other U.S. Waste Form Programs

In preliminary evaluations[5,6] of waste forms for immobilizing Hanford and Idaho high-level waste, borosilicate glass and crystalline ceramic forms were consistently ranked among the top candidate waste forms. Borosilicate glass is the reference form for the high-level waste at West Valley, but other alternatives are being examined.[7] The program to select a waste form for future commercial high-level waste is being developed.

2.3.2 Other High-Level Waste Disposal System Programs

The waste form produced in the DWPF must be compatible with the transportation systems developed for shipping the canisters of waste to a repository. The waste forms will be the innermost of the waste package components to be emplaced in a geologic repository. The National Waste Terminal Storage (NWTS) Program has the responsibility for developing the technology and the repositories for disposal of high-level waste. Figure 2.1 of the DWPF EIS[1] shows the coordination of the DWPF with the transportation and repository programs. Information on waste form descriptions, waste package designs, product and performance specifications, repository designs, conditions, and risk analyses is routinely exchanged among all programs to ensure consistency and compatibility.

2.3.3 International Waste Form Programs

All other nations now performing or planning nuclear fuel reprocessing have selected borosilicate glass as the waste form to immobilize high-level waste (the USSR is still using phosphate glass as well as borosilicate glass). France has been in full production of vitrified (borosilicate glass) waste canisters since 1978. Belgium, Germany, Japan, the Netherlands, Sweden, and Switzerland have contracted to have their spent fuel reprocessed in France and to have the vitrified waste returned along with purified products. Current research in the European countries and Japan is focused on the development of borosilicate glass processes for immobilizing commercial high-level waste. The goal in several countries (e.g., Belgium, Germany, U. K., and Japan) is to have their own fuel reprocessing and waste vitrification facilities. Further details on these international waste form programs are given in Appendix A.

Some work is also being performed abroad on crystalline ceramic waste forms, particularly in Australia and Japan. The Synroc concept of a titanate mineral waste form, which is the basis for much of the current effort on crystalline ceramic waste forms, was originated by Professor A. E. Ringwood[8] at the Australian National University. Both Professor Ringwood and the Australian Atomic Energy Commission are continuing to develop these forms.

REFERENCES FOR CHAPTER 2

1. **Final Environmental Impact Statement, Defense Waste Processing Facility, Savannah River Plant, Aiken, SC.** USDOE Report DOE/EIS-0082, U.S. Department of Energy, Washington, DC (February 1982).

2. **The Evaluation and Review of Alternative Waste Forms for Immobilization of High-Level Radioactive Wastes.** USDOE Report DOE/TIC-10228, U.S. Department of Energy, Alternative Waste Form Peer Review Panel (August 1979).

3. **The Evaluation and Review of Alternative Waste Forms for Immobilization of High-Level Radioactive Wastes.** Report Number 2. USDOE Report DOE/TIC-11219, U.S. Department of Energy, Alternative Waste Form Peer Review Panel (June 1980).

4. **The Evaluation and Selection of Candidate High-Level Waste Forms.** USDOE Report DOE/TIC-11611, U.S. Department of Energy, Savannah River Operations Office (March 1982).

5. W. W. Schultz et al. **Preliminary Evaluation of Alternative Forms for Immobilization of Hanford High-Level Defense Wastes.** USDOE Report RHO-ST-32, Rockwell Hanford Operations (September 1980).

6. R. G. Post. **Independent Evaluation of Candidate Alternative ICPP High-Level Waste Forms.** USDOE Report ENICO-1088, Exxon Nuclear Idaho Company (June 1981).

7. **Draft Environmental Impact Statement, Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley.** USDOE Report DOE/EIS-00810, U.S. Department of Energy, Washington, DC (July 1981).

8. A. E. Ringwood. **Safe Disposal of High-Level Nuclear Reactor Wastes: A New Strategy.** Australian National University Press, Canberra (1978).